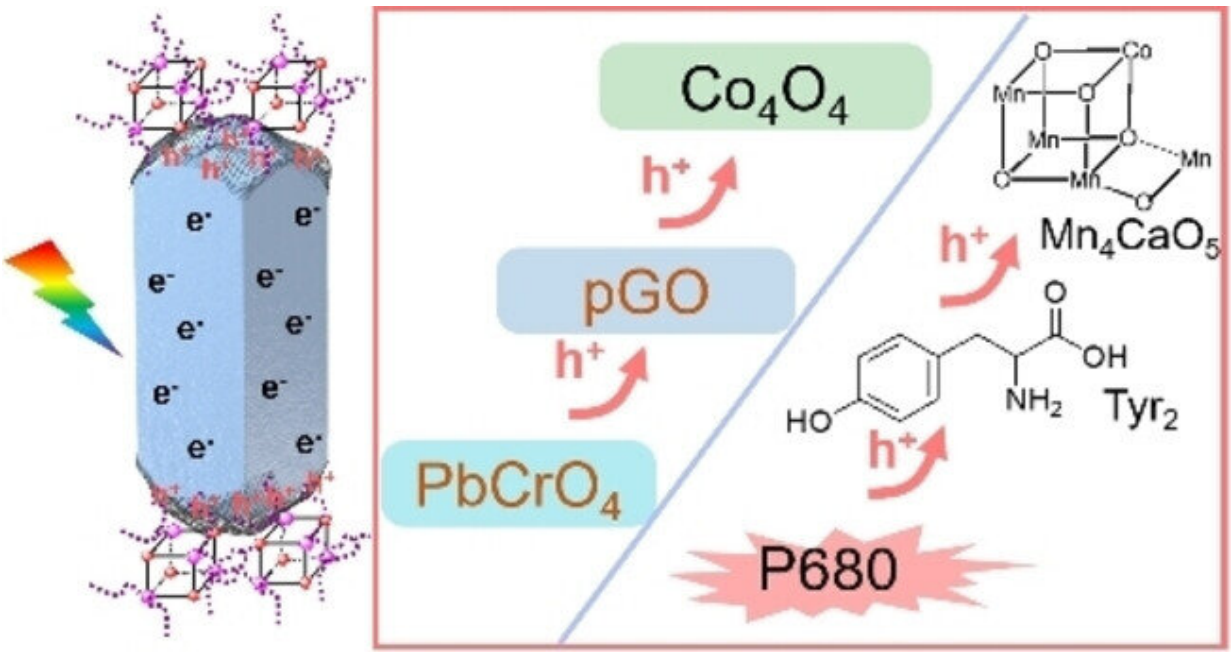
Researchers develop interfacial charge modification strategy to enhance photocatalytic water oxidation

May 5 2023, by Li Yuan



Partially oxidized graphene (pGO) operates as a charge-transfer mediator between the water oxidation cocatalyst (Co_4O_4) and the hole-accumulating {−101} facets of $PbCrO_4$. Unimpeded transfer of photogenerated holes from $PbCrO_4$ to Co_4O_4 via the pGO mediator is demonstrated. The resulting Co_4O_4/pGO/$PbCrO_4$ photocatalyst oxidizes water with an apparent quantum efficiency exceeding 10 % at 500 nm. Credit: *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202302575

Water oxidation reaction involves a four-electron and four-proton transfer process, which requires an uphill energy transformation and limits the efficiency of the overall photocatalytic water splitting reaction.

Although loading appropriate water oxidation cocatalysts can enhance the performance of water oxidation reactions, the interfacial barrier between the semiconductor and the water oxidation cocatalyst can impede the transfer and utilization of photogenerated charges.

Recently, a research team led by Profs. Li Can and Li Rengui from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has developed a strategy to controllably assemble a charge-transfer mediator in photocatalysis, which could increase surface charge-transfer efficiency and photocatalytic water oxidation activity. The study was published in *Angewandte Chemie International Edition* on March 23.

Inspired by natural photosynthesis, the researchers employed partially oxidized graphene (pGO) as a charge-transferring mediator on the hole-accumulating facets of lead chromate ($PbCrO_4$) photocatalyst. The pGO could be selectively assembled on the hole-accumulating facets of $PbCrO_4$ by an ultrasonic deposition process, and cobalt-complex Co_4O_4 molecules could be anchored on the pGO as water oxidation cocatalyst.

Based on techniques such as surface photovoltage spectroscopy, they confirmed that introducing the pGO charge transfer mediator between the hole-accumulation facets of $PbCrO_4$ and Co_4O_4 molecules could effectively suppress charge recombination at the interface, thus prolonging the lifetime of photogenerated charges and enhancing photocatalytic water oxidation performance.

"The strategy of rationally assembling charge transfer mediator provides a feasible way for accelerating charge transfer and charge utilization in

semiconductor photocatalysis," said Prof. Li Rengui.

More information: Wenchao Jiang et al, Graphene Mediates Charge Transfer between Lead Chromate and a Cobalt Cubane Cocatalyst for Photocatalytic Water Oxidation, *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202302575